

History of the Calendar

in Different Countries Through the Ages

**M.N. Saha
and
N.C. Lahiri**



COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
Rafi Marg, New Delhi-110001
1992

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THE ZODIAC THROUGH THE AGES



MAGNITUDES.

- FIRST ●
- SECOND ●
- THIRD ●
- FOURTH ●
- FIFTH ●

POSITIONS OF THE FIRST POINT OF ARIES (♈) IN DIFFERENT TIMES.

V = Vedic Times about	2300 B.C.
H = Hipparchos	140 B.C.
Pt = Ptolemy	150 A.D.
S ₁ = Sūrya Siddhānta	285 A.D.
S ₂ = "	500 A.D.
S ₃ = "	570 A.D.
M = Modern	1950 A.D.

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product of the huge amount of astrological nonsense, a few pearls in a huge mass of dung, as Alberuni observed nearly ten centuries ago. Let us see when these "pearls" gradually crystallized out of the dung-heap.

Two texts called '*Mul Apin*' dated round about 700 B.C. have been discovered which contain summary of the astronomical knowledge of the time. Here is one of the pertinent passages from Neugebauer's *Exact Sciences in Antiquity* (p. 96).

"They are undoubtedly based on older material. They contain a summary of the astronomical knowledge of their time. The first tablet is mostly concerned with the fixed stars which are arranged in three "roads", the middle one being an equatorial belt of about 30° width. The second tablet concerns the planets, the moon, the seasons, lengths of shadow, and related problems. These texts are incompletely published and even the published parts are full of difficulties in detail. So much, however, is clear: we find here a discussion of elementary astronomical concepts, still quite descriptive in character but on a purely rational basis. The data on risings and settings, though still in a rather schematic form, are our main basis for the identification of the Babylonian constellations."

The passage indicates that the Chaldean astronomers of this period could locate the north pole, and had come to an idea of the celestial equator, and could

cuts the horizon at the east and west points as determined by the gnomon.

The Ecliptic:—From archæological records, it is generally held that a knowledge of the star-groups lying

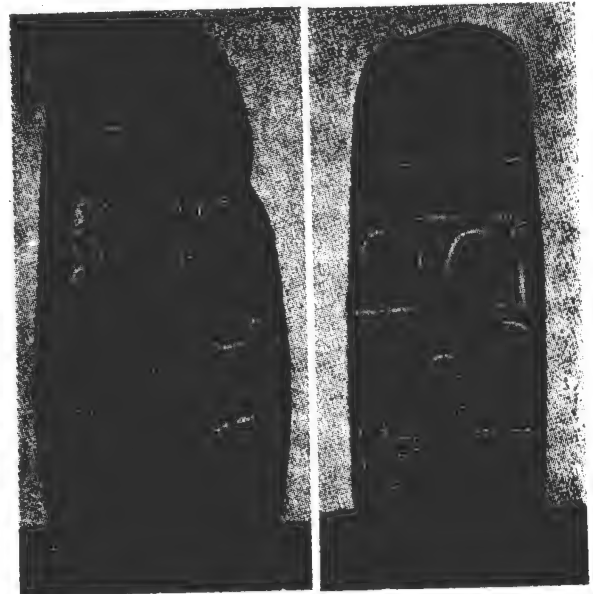


Fig. 15—Two sculptured stones of ancient Babylon displaying the Sun, the Moon, Venus and Scorpion—symbols of a primitive astrological science which fathered the modern conception of astronomy.

close to the ecliptic was obtained in Babylon as early as

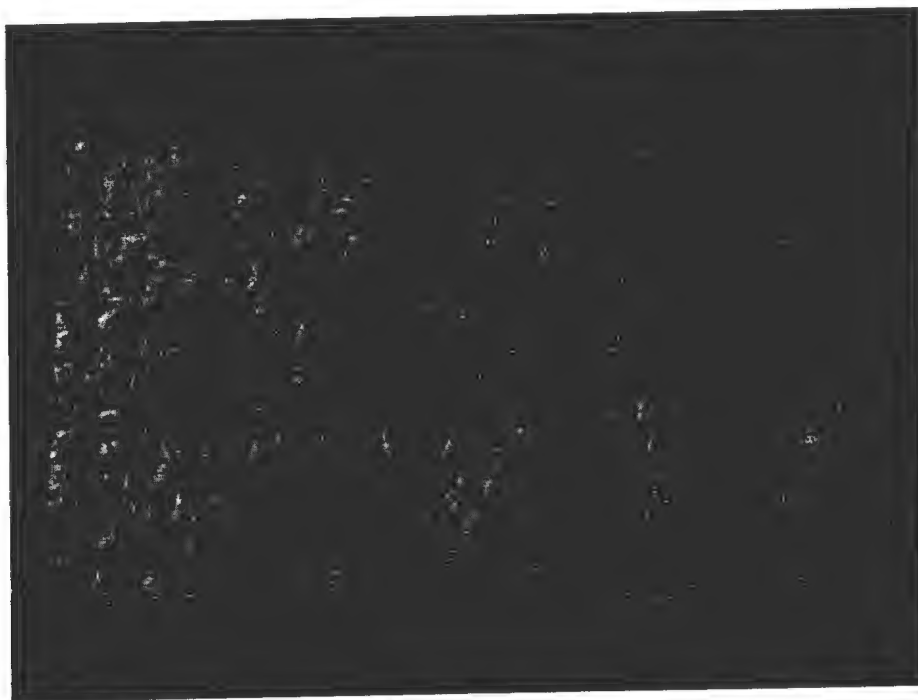


Fig. 16—Babylonian Boundary Stone showing Pythagorean numbers (Plimpton 322).

(Reproduced from Neugebauer's *Exact Sciences in Antiquity*)

trace it in the heavens. We do not know when they came to the knowledge that the celestial equator

1300 B.C., for some of the ecliptic star-groups like the Cancer, or Scorpion are found portrayed on boundary

stones which can be dated 1300 B.C. Neugebauer and Sachs maintain that the ecliptic is first found mentioned in a Babylonian text of 419 B.C., but its use as a reference plane must have started *much* earlier, probably before 550 B.C. But the steps by which the knowledge of stars marking the ecliptic

Probably the first stage was to determine the angular distance of heavenly bodies from some 'Normal Stars' as indicated by Sachs.* These normal stars were stars either on the ecliptic, like Regulus, Spica, or α *Librae* or some other stars close to it. Sachs gives a list of 34 such normal stars. Probably the



Fig. 17—Babylonian Boundary stone showing lunar ephemeris engraved on it (A. 3412 Rev.) (*Exact Sciences in Antiquity*)

was obtained, are not yet known with precision. Only some guesses can be made.

The early astronomers probably observed that the bright stars Regulus (α *Leonis*), Spica (α *Virginis*), the conspicuous group Pleiades, and certain fainter stars α *Librae*, α *Scorpii* were almost on the sun's path. The ecliptic could be roughly constructed by joining these stars.

'Regulus' or α *Leonis* was the 'Royal Star' in Babylonian mythology. In Indian classics, it is known as *Maghā* (or the Great) and the presiding deity is *Indra*, the most powerful Vedic god. It is almost exactly on the ecliptic. *Citrā* (or α *Virginis*) is 2° to the south.

The First Point of Aries :—The first point of Aries is the fiducial point from which all astronomical measurements are made. But how was this point, or any other cardinal point, say the first point of Cancer (summer solstice), the first point of Capricornus (winter solstice) and the first point of Libra, were located on the circle of the ecliptic in early times?

For rarely have the first point of Aries nor any other of the cardinal points been occupied by prominent stars during historical times. Even if for measurement, the ancient astronomers used some kind of astronomical instrument, say the armillary sphere, it would be difficult for them to locate the first point of Aries correct within a degree.

ecliptic positions of these normal stars were determined after some effort by some method not yet known, and then the positions of other heavenly



Fig. 18—Armillary sphere.
(Reproduced from *Encyclopaedia Britannica*).

bodies referred to the first point of Aries or the beginning of a sign could be found. The early observations are rough and no accuracy of less than a degree is claimed by any classical scholar for them.

* A. Sachs, Babylonian Horoscopes, p. 53, *Journal of Cuneiform Studies*, Vol. VI. No. 2.

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Aries, are the months ; of them is made up the year (10).

These quotations leave not the slightest doubt that according to the compilers of the S.S., the first point of the zodiac is the point of intersection of the ecliptic and the equator, and the signs of the zodiac cover 30° each of the ecliptic.

It is supposed on good grounds that much of the astronomical knowledge found in the *Sūrya Siddhānta* is derived from Graeco-Chaldean sources. But it is clear from the text that the compilers of the S.S. had no knowledge of the precession of equinoxes, but they took the first point of Aries to be fixed. This is not to be wondered at, for as shown in § 4.9, inspite of the works of Hipparchos and Ptolemy, precession was either not accepted or no importance was attached to it by the astronomers of the Roman empire. It may be added that the compilers of the S.S. were not aware of the theory of trepidation of equinoxes which appears to have been first formulated in the West by Theon of Alexandria (ca. 370 A.D.). It is also important to note that the Indian astronomers did not take the first point of Aries to be identical with that given either by Hipparchos, Ptolemy or any other western authority as would have been the case if there was blind-folded borrowing. They assimilated the astronomical knowledge intelligently and took the first point of Aries as the point of intersection of the equator and the ecliptic, and made successive attempts to determine it by some kind of actual observations, as shown in appendix 5-B. These observations appear first to have been made about 280 A.D.

Length of the Year

The length of the year, according to the different authorities are as follows.

<i>Sūrya Siddhānta</i> of	days
Varāhamihira ... 365 ^d 6 ^h 12 ^m 36 ^s	=365.25875
Current S.S. ... 365 6 12 36.56	=365.258756
Ptolemy (sidereal) 365 6 9 48.6	=365.256813
Correct length of the sidereal year...	
365 6 9 9.7	=365.256362
Correct length of the tropical year...	
365 5 48 45.7	=365.242196

N. B. Varāhamihira's length of the year is also found in Āryabhaṭa's *ārdharātri*, or midnight system, and in Brahmagupta's *Khaṇḍa Khādyaka*.

How did the Indian savants manage to have such a wrong value for the length of the year ?

The year, according to the *Sūrya Siddhānta*, is meant to be clearly tropical, but as the Indian savants compiling the S.S. were ignorant of the phenomenon of

precession of the equinoxes, they were unaware of the distinction between the sidereal year and the tropical year. They had to obtain the year-length either from observation or from outside sources. If they obtained it from observations, they must have counted the number of days passed between the return of the sun to the same point in the sky over a number of years. Such observations would show that the year had not the traditional value of 366 days given in *Veāṅga Jyotiṣa*, but somewhat less. In fact, the *Paiāmaha* length is 365.3569 days and there is no reason to believe that it was derived from foreign sources. Successive observations must have enabled the Indian savants to push the accuracy still higher.

Or alternatively they might have borrowed the value from Graeco-Chaldean astronomy, but we cannot then explain why their value is larger than Ptolemy's. We have seen that the *Romaka Siddhānta* gives a value which is Hipparchos's, and tropical, but the three more correct Siddhāntas reject it, as being too small. This however indicates that they probably tried to derive the length from observations as stated in the previous paragraph and found the *Romaka Siddhānta*-length too small. If they had taken it from some other source, we have still to discover that source. It is certainly not Ptolemy's *Almagest*.

The ex-cathedra style of writing adopted by the Siddhāntic astronomers, e.g., the number of days in a *Kalpa* (a period of 4.32×10^9 years) is 1,577,917,828,000 according to Grandfather *Brahmā*, or the Sungod, does not enable one to trace the steps by which these conclusions were reached.

The two problems of (i) distinguishing between the tropical year, and the sidereal year and of (ii) determining the correct length of the year in terms of the mean solar days are very exacting ones.

We have seen how it took the West the whole time-period between 3000 B.C. to 1582 A.D. to arrive at the idea that the true length of the tropical year was close to 365.2425 days. Probably Iranian astronomers of Omar Khayam's time (1072 A.D.), who had the advantage of the great Arabian observations by al-Baṭṭānī and others had a more correct knowledge of this length. The final acceptance of the distinction between the tropical and the sidereal year dates only from 1687 A.D., when Newton proved the theory of trepidation to be wrong.

The Siddhāntic astronomers of 500-900 A.D. cannot therefore be blamed for their failure to grasp the two problems. But what to say of their blind followers who, in the twentieth century, would continue to proclaim their belief in the theory of trepidation ?

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Table 27.

Indian Eras

ERA	Zero-year of Era	Year of era current in 1954 A. D. (latter part)	Date of commencement in 1954 A. D.	Year-beginning		Pūrṇimānta or Amānta (Lunar months)	Provenance	Remarks
				Solar	Luni-Solar			
Kali Yuga	A. D. -3101	5055	April	Meṣādi (Ver. equi.)	Chaitra S 1	—	—	Extrapolated
Saptarṣi	-3176	—	—	—	Chaitra S 1	Pūrṇimānta	Kashmir	—
Yudhiṣṭhira	-2448	—	—	—	—	—	—	—
Laukika	724 (?)	—	—	—	—	—	—	—
Buddha Nirvāṇa	-544	2498	May 17	—	Vaiśākha S 15	—	Multan & Kashmir	Adopted by Kalhana
Mahāvīra Nirvāṇa	-527	2481	—	—	Kārtika S 1	—	Ceylon	—
Vikrama (I)	57	2011	April 4	Vernal equinox	Chaitra S 1	Pūrṇimānta	N. India except Bengal } Gujarat } Kathiawar }	—
" (II)	57	2011	Oct. 27	—	Kārtika S 1	Amānta		Earlier known as Kṛta or Malavagana.
" (III)	57	2011	July 1	—	Āṣāḍha S 1	Amānta		—
Christian	0	1954	Jan. 1	Jan. 1	—	—	World	—
Saka	78	1876	April	Meṣādi (Vernal equinox)	Chaitra S 1	P (N. India) A (S. India)	All India	Astronomer's era
Chedi (Kālācūri)	248	—	—	—	Āśvina S 1	Pūrṇimānta	Western & Central India	—
Vallabhi	318	—	—	—	Kārtika S 1	Both P. & A.	Kathiawar & Saurashtra	From Gupta era
Gupta	319	—	—	—	Chaitra S 1	Pūrṇimānta	Gupta empire (Cen. I. & Nep.)	—
Harṣa	606	—	—	—	—	—	Mathura & Kanauj	—
Hejira	622	1374	Aug. 31	—	Muharram (Lun.)	—	—	Lunar reckoning
Bengali San	—	1361	April 14	Meṣādi	—	—	Bengal	963 + Solar years since 1556
Vilāyati	—	1362	Sept. 16	Kanyādi	—	—	Bengal & Orissa	—
Amli	—	1362	Sept. 10	—	Bhādra S 12	—	Orissa	—
Fasli (I)	—	1362	Sept. 13	—	Bhādra K 1	Pūrṇimānta	Bengal	992 + Solar years since 1584
" (II)	—	1364	July 1	July 1	—	—	Deccan	—
" (III)	—	1364	June 8	Sun enters Mṛga nakṣ.	—	—	Bombay	—
Magi	638	—	—	Meṣādi	—	—	Arakan, Chittagong	Similar to Bengali San
Gaṅgā	—	—	—	—	—	—	Eastern Deccan	—
Kollam (I)	824	1130	Sept. 17	Kanyādi	—	—	North Malabar	—
" (II)	824	1130	Aug. 17	Sinhādi	—	—	South Malabar	—
Newar	879	—	—	—	Kārtika S 1	Amānta	Nepal	In vogue till 1768 A. D., suppressed by Gurkhas.
Cālukya Vikrama	1075	—	—	—	—	—	Western Deccan	Current only for 100 years.
Lakṣmana Sena	1104-1118	—	—	—	—	—	Mithila	—
Sinhā	1113	—	—	—	Kārtika S 1	Amānta	Gujarat	Started by Siddharāja Jayasimha
Tārīkh Ilāhi	1555	—	—	—	Āṣāḍha S 1	—	Akber's empire	Introduced by Akber (963 Hejira)
Rāja Śaka	1673	—	—	Vernal equinox	Jyēṣṭha S 13	Amānta	Maharashtra	From the coronation of Śivāji

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